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March 18, 1993

Elaine Pearl
Research Grants Specialist
Space Sciences Directorate Procurement Office
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

RE: NASA Grant No. NAG5-770

Dear Ms. Pearl:

Enclosed herewith is one copy of the final technical report for the above-referenced grant.

Sincerely,

Rick A. Dunn
Assistant Director
Office of Research and Technology Transfer

JV/dh

Enc.

cc: David A. Yuen

FINAL TECHNICAL REPORT OF NASA NAG 5770

Geodynamical Investigation of Mantle Rheology Over Short and Intermediate Timescales

P.I.: David A. Yuen, University of Minnesota

AGENCY NO. NASA/NAG5-770
U of M no : 0624-5563
Period covered by this report: 4/1/86 to 7/31/91

During this five years we have conducted research in the following areas of geodynamics which are relevant to the goals set out in this proposal:

(1) The effects of transient rheology in postglacial rebound and earth rotational signatures.

(2) The effects of mantle convection on geodynamical signatures from depth-dependent properties from thermal-chemical instabilies at the core-mantle boundary.

(3) The effects of phase-boundaries and chemical boundaries on long-term polar rotation.

(4) The effects of equation of state and depth-dependent thermal expansivity on geoids and surface topography.

(5) The effects of a hard garnet layer on postglacial rebound and geoid signatures.

(6) The effects of mantle phase transitions on generating diapiric flows in the upper-mantle.

The publications resulting from this research are listed below according to the above topics:

(1) On transient rheology and glacial isostasy, (with R. Sabadini and E. Boschi), J. Geophys. Res., 91, 11420-11438, 1986.

Consequences of experimental transient rheology, (with R. Sabadini and B.K. Smith), Geophys. Res. Lett., 14, 816-819, 1987.

Viscoelastic deformations and temporal variations in the geopotential, (with R. Sabadini and P. Gasperini), Slow Deformation and Transmission of Stress in the Earth, ed. by S. Cohen and P. Vernesack, 111-124, American Geophysical Union Monograph, vol.49, Washington, D.C., 1989.

Azimuthal dependence of the variation in the higher harmonic gravity field from recent and past cryospheric forcings, (with P. Gasperini, R. Sabadini and E. Boschi), Geophys. Res. Lett., 14, 812-815, 1987.

Postglacial relaxation of a viscously stratified compressible spherical shell, (with J. Wu), Geophys. J. Int., 104, 331-349, 1991.

(2) Deformation of the core-mantle boundary induced by spherical shell, compressible convection, (with Shuxia Zhang), Geophys. Res. Lett., 14, 899-902 1987.

The effects of adiabatic and viscous heatings on plumes, (with W. Zhao), Geophys. Res. Lett., 14, 1223-1227, 1987.

Dynamical effects on the core-mantle boundary from depth-dependent thermodynamical properties of the lower mantle, (with S. Zhang), Geophys. Res. Lett., 15, 451-454, 1988.

Numerical simulations of thermal-chemical instabilities at the core-mantle boundary, (with U. Hansen), Nature, 334, 237-240, 1988.

Subcritical double-diffusive convection at infinite Prandtl number, (with U. Hansen), Geophys. Astrophys. Fluid Dyn., 47, 199-224, 1989.

Dynamical influences from thermal-chemical instabilities at the core-mantle boundary (with U. Hansen), Geophys. Res. Lett., 16, 629-632, 1989.

(3) Mantle stratification and long-term polar wander, (with R. Sabadini), Nature, 339, 373-375, 1989.

Eustatic sea-level fluctuations induced by polar wander (R. Sabadini and C. Doglioni), Nature, vol. 345, 708-710, 1990.

(4) A computer-aided, algebraic approach to the postglacial rebound problem (with Giorgio Spada, R. Sabadini), The Mathematica Journal,1, 65-69, 1990.

Mantle convection with internal-heating and pressure-dependent thermal expansivity, (with A.M. Leitch and G. Sewell), Earth Planet. Sci. Lett., vol. 102(2), pp. 213-232, 1991.

Dynamical Influences of the Pressure Dependence of Thermal Expansivity on Mantle Convection (with Ulli Hansen and M. A. Leitch), in press, Glacial Isostasy, Sea-Level, and Mantle Rheology, ed. by R. Sabadini and K. Lambeck, Kluwer Academic Publish., 663-701, 1991.

(5) Effects on postglacial rebound from the hard rheology in the transition zone (with G. Spada, R. Sabadini and Y. Ricard) submitted to Geophys. J. Int., 1991.

Dynamical effects on topographies and geoid anomalies due to internal loading from equation of state, (with H.-J. Hong), J. Geophys. Res., 95, 19, 933-19, 948, 1990.

Dynamical effects of a hard layer in the transition zone on surface signatures: postglacial rebound and geoid, (with J. Wu and H.J. Hong), Phys. Earth Planet. Int.,64, 37-51, 1990.

(6) Diapiric instabilities in the upper mantle due to phase transitions, (with M.Liu, W. Zhao and S. Honda) Science, in press,1991.